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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|-------------|----------------------|---------------------|------------------|
| 10/810,309 | 03/26/2004 | Isamu Akasaki | 81716.0122 | 8006 |
| 26021 | 7590 | 07/26/2005 | EXAMINER | |
| HOGAN & HARTSON L.L.P. 500 S. GRAND AVENUE SUITE 1900 LOS ANGELES, CA 90071-2611 | | | LE, THAO X | |
| | | ART UNIT | | PAPER NUMBER |
| | | | | 2814 |

DATE MAILED: 07/26/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | | |
|------------------------------|------------------------|---------------------|--|
| Office Action Summary | Application No. | Applicant(s) | |
| | 10/810,309 | AKASAKI ET AL. | |
| | Examiner | Art Unit | |
| | Thao X. Le | 2814 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 06 July 2005.
 2a) This action is FINAL. 2b) This action is non-final.
 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 1-32 is/are pending in the application.
 4a) Of the above claim(s) 1,3,5,7,9,14,16-18 and 20-32 is/are withdrawn from consideration.
 5) Claim(s) _____ is/are allowed.
 6) Claim(s) 2,4,6,8,10-13,15 and 19 is/are rejected.
 7) Claim(s) _____ is/are objected to.
 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
 10) The drawing(s) filed on 26 March 2004 is/are: a) accepted or b) objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date <u>07/02/04</u> . | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of claims 2,4,6,8,10-13, 15 and 19 in the reply filed on 06 July 2005 is acknowledged.

Drawings

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description: 28 in fig. 17. Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claim 15 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 15 recites the limitation "wherein an angle Θ_1 formed by normal line of the principal surface of the substrate and a normal line of the (0001) plane of the substrate is $0^\circ \leq \Theta_1 \leq 5^\circ$. There is insufficient antecedent basis for this limitation in the claim.

Assuming the angle is used for forming the semiconductor buffer layer,

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

6. Claims 2, 4, and 8 are rejected under 35 U.S.C. 102(e) as being anticipated by US 6583468 to Hori et al.

Regarding claim 2, Hori discloses a semiconductor apparatus in fig. 3 comprising: a substrate 1 made of a diboride single crystal, column 6 lines 12-13 expressed by a chemical formula XB_2 , in which X includes at least one of Ti, Zr, Nb and Hf, column 6 line 13; a semiconductor buffer layer 2, column 4 line 67, formed on a

principal surface of the substrate 1 and made of $(\text{AlN})_x(\text{GaN})_{1-x}$ ($0 < x \leq 1$) or AlN when $x=1$, column 4 line 67, nitride semiconductor layer 3 formed on the semiconductor buffer layer 2, including at least one kind or plural kinds selected from among 13 group elements and As, column 5 line 2 (n-GaN).

Regarding claim 4, Hori discloses the semiconductor apparatus of claim 1, wherein the substrate 1 is of ZrB_2 or TiB_2 , column 6 line 13

Regarding claim 8, Hori discloses the semiconductor apparatus of claim 2, wherein the semiconductor buffer layer 2 is AlN, column 4 line 67.

7. Claims 15, 19 are rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over US 6583468 to Hori et al.

Regarding claims 15, 19, Hori discloses the semiconductor apparatus of claim 2, wherein the substrate is eroded and removed by etching.

The process limitations ‘an angle $\Theta 1$ formed by normal principal surface of the substrate’, ‘eroded’ or ‘etching’ in claims 15 and 19 do not carry weight in a claim drawn to structure. In re Thorpe, 277 USPQ 964 (Fed. Cir. 1985). In addition, the recitation of ‘angle $\Theta 1$ formed by normal principal surface of the substrate’, ‘eroded’ or etching of the claimed invention does not result in a structural difference between the claimed invention and the prior art, thus claimed invention is only an art recognized suitability for an intended purpose, MPEP 2144.07.

8. Claims 2, 4, and 6 are rejected under 35 U.S.C. 102(e) as being anticipated by US 6566218 to Otani et al.

Regarding claim 2, Otani discloses a semiconductor apparatus in fig. 7 comprising: a substrate 30 made of a diboride single crystal, column 4 lines 50, expressed by a chemical formula $X\text{B}_2$, in which X includes at least one of Ti, Zr, Nb and Hf, column 4 line 51; a semiconductor buffer layer 11, column 4 line 67, formed on a principal surface of the substrate 1 and made of $(\text{AlN})_x(\text{GaN})_{1-x}$ ($0 < x \leq 1$) or GaN, fig. 7, a nitride semiconductor layer 16 formed on the semiconductor buffer layer 11, including at least one kind or plural kinds selected from among 13 group elements and As, column 5 line 2 (n-GaN), fig. 7.

Regarding claim 4, Otani discloses the semiconductor apparatus of claim 1, wherein the substrate 30 is of ZrB_2 or TiB_2 , column 4 line 51

Regarding claim 6, Otani discloses the semiconductor apparatus of claim 2, wherein the substrate 30 is a solid solution containing one or a plurality of impurity elements of 5 atom % or less, the one or a plurality of impurity elements being selected from a group consisting of Ti, Cr, Hf, V, Ta and Nb when the substrate is of ZrB_2 , or selected from a group consisting of Zr, Cr, Hf, V, Ta and Nb when the substrate is of TiB_2 , column 5 lines 50-62.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

Art Unit: 2814

invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

11. Claims 10-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 6583468 to Hori et al. in view of US 680948 to Koike et al.

Regarding claims 10-11, Hori does not disclose the thickness of the semiconductor buffer layer made of AlN is about 10-250 nm or 10-100 nm.

But Hori discloses the semiconductor apparatus of claim 8, wherein the thickness of the semiconductor buffer layer made of AlN is about 500 nm, column 6 line 4. Accordingly, it would have been obvious to one of ordinary skill in art to use the thickness of Hori in the range as claimed, because it has been held that where the general conditions of the claims are disclosed in the prior art, it is not inventive to discover the optimum or workable range by routine experimentation.

See *In re Aller*, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955).

Regarding claims 12-13, Hori does not disclose the semiconductor apparatus of claim 2, wherein x of the semiconductor buffer layer made of $(\text{AlN})_x(\text{GaN})_{1-x}$ is $0.1 \leq x \leq 0.1$ or $0.4 \leq x \leq 0.6$.

However, Hori discloses the conventional buffer layer 2 is made of GaN having Al element at least 50% atomic percentage, column 5 line 39-46. Furthermore, Koike discloses the buffer layer having the composition of $\text{Al}_x\text{Ga}_{x-1}\text{N}$ ($0 \leq x \leq 1$), column 8 line 26. At the time the invention was made; it would have been obvious to one of ordinary skill in the art to use the buffer layer teaching of Koike with Hori's buffer layer, because it would have suppressed generation of threading dislocation as taught by Koike. In addition, it would have been obvious to one of ordinary skill in art to use the teaching of Koike and Hori in the range as claimed, because it has been held that where the general conditions of the claims are disclosed in the prior art, it is not inventive to discover the optimum or workable range by routine experimentation. See *In re Aller*, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955).

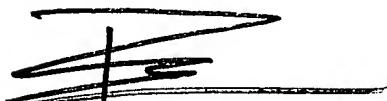
The formula $(\text{AlN})_x(\text{GaN})_{1-x}$ is $0.1 \leq x \leq 0.1$ or $0.4 \leq x \leq 0.6$ is being interpreted as for example when $x=0.4$, then it would be $\text{Al}_{0.4}\text{N}_{0.4}\text{Ga}_{0.6}\text{N}_{0.6}$. Thus, this formula would be chemically equivalent to $\text{Al}_{0.4}\text{Ga}_{0.6}\text{N}$.

Conclusion

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thao X. Le whose telephone number is (571) 272-1708. The examiner can normally be reached on M-F from 8:00 AM - 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael M. Fahmy can be reached on (571) 272 -1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Thao X. Le
Patent Examiner
21 July 2005